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VOL. X.—No. 216.

THE BLOCK SYSTEM AND THE CANONBURY ACCIDENT.

THE lamentable disaster at Canonbury is a melancholy illustration of the mischief which may be wrought by the failure of the human agency which is so indispensable in carrying out the details of block signalling.

So far as can be seen from the accounts before us it would appear that the section of railway upon which the catastrophe occurred was well constructed, and the men engaged in signalling the trains and conducting the traffic were steady and zealous in their work.

The recent verdict, given as the result of the inquest held at Holloway, is to the effect that the disaster was the direct result of the unauthorised mode of working the four passenger trains, introduced by the signalman, and that the latter committed a grave error of judgment. The jury further expressed their opinion that the words "permissive block" should be expunged from the North London Railway Company's code of instructions. Considering the nature of the inquiry, the jury were no doubt unable to condemn the "permissive" rule in stronger terms than they did. In our opinion such words as "permissive" or "absolute" are entirely unnecessary in connection with block working; in fact, what is known to us as a permissive "block," seems to be no "block" at all, and we think the use of the expression highly objectionable. It is to be regretted that any qualification of the simple word "block" should ever have been allowed to exist in the vocabulary of the railway signaller.

The want of uniformity in the technical terms used in signalling instructions and correspondence on the various lines of railway is, we think, much to be deplored; as an instance we may say that we have known signallers use the words ON, OFF, IN and OUT to convey the meaning of a single signal, viz., the departure of a train, while three of these words are also used by some to signify the arrival of a train.

The worst point, however, in this respect, and one that seems painfully prominent just now, is the difference in the codes in use for working the train signalling bells on the various railways. The companies seem generally to agree as to the use of green, red, and white lights on their outdoor signals, and it seems incomprehensible to us why some universal code should not be agreed upon, at least for the important signals of "obstruction on line" and "line clear" upon the train signalling bells. This seems as great a necessity to us as the adoption of the universal Morse code in commercial telegraphy.

We know that this question of a bell code has been discussed by the Railway Clearing House, and it is a very large one; also that every railway company has a staff of officials ready to prove that their own particular code is the best suited to their own requirements, and that of the railway world generally; but since the immense development of the principle of interchanging traffic has brought about the result that every line of railway mingles at some point or another with several others, the introduction of conflicting "Clear" and "Obstruction" codes at several of the stations on each system of railway is a natural consequence.

It may not, perhaps, be practicable with the several forms of Block Telegraph instruments in use to introduce entire uniformity of code in all its details, but we contend that these two codes may be as distinctly universal in this country as the language in which they are expressed.

We do not appreciate the necessity of any one company requiring two different obstruction signals.

It may be anticipated that recent events will bring into prominence the advisability of combining the system of mechanical interlocking of out-door signals with the electrical instruments, so that while the electrical indicator is at danger—as it admittedly was in the case under notice—no misinterpretation of a varying code of bell signals shall leave a signalman with the power, even if he has the will, to break the integrity of the block system. This has already been carried ont to a certain extent upon some lines of railway, and as it can well be done, and still utilise the existing block apparatus, we confidently look forward to this further development of the block system as one of the positive requirements of the future, more especially as the jury in their verdict at Holloway strongly recommended the adoption of such a system.

ELECTRIC LIGHT MEASUREMENTS.

By H. R. KEMPE.

II.

FIG. 2 shows the form of tangent galvanometer referred to in the last article, and which is a suitable one for making measurements of the nature of those described. The instrument does not possess any great peculiarities calling for special notice; the brass frame ring on which the wire is wound is 8 inches in external and 5 inches in internal diameter, and the width of the groove in which the wire is wound is $\frac{1}{4}$ of an inch. The small key on the brass base is for the purpose of short-circuiting the galvanometer coil. This form of key enables the oscillations of the needle to be checked with much greater ease than is the case when an open circuit key is used. The two terminals on either side of the key are those to be used when the high resistance coil is required. The other two terminals are connected to a few turns of thick wire (having practically no resistance) wound outside the other coil, and are useful for enabling the resistance of the one cell Daniell battery to be determined.

This description of galvanometer is precisely similar in form to that employed by the General Post Office for testing purposes, except that the coil is wound to 1,000 ohms instead of 320, and two resistance coils and plugs and a fifth terminal, which are attached to the Post Office instrument, are omitted.

The dial plate of the galvanometer is graduated on one side in degrees and on the other in divisions proportional to the tangents of those degrees, so that if the readings are taken from the latter scale no reduction to tangents is necessary. As simplicity, where possible, is advisable, it is always as well in measurements such as we are considering, to take the readings on the last-named scale, and we shall assume that this is done unless the contrary is stated.

Perhaps, the best form of Daniell cell for producing the standard current is that used by the Post Office. This cell,

which is shown by fig. 3, is formed with three chambers; in the left-hand one is placed a zinc plate, z, immersed in water, and in the right-hand one is placed a flat porous pot, c, containing a copper plate and sulphate of copper crystals, the pot being kept immersed in water. The two chambers are called "idle" cells, as the zinc and porous pot are kept in them when the the cell is not in use. The centre chamber contains a semi-saturated solution of sulphate of zinc, and a piece of zinc rod, *z*, the latter lying in a small compartment at the bottom of the chamber. When the cell is required for use, the zinc plate and the porous pot and its contents are removed from their idle cells and placed in the centre chamber; the cell is then ready for work. When the cell is no longer required for use, the zinc plate and porous pot are again placed in their respective idle chambers, and whilst the cell is at rest any sulphate of copper solution which may have become mingled with the sulphate of zinc

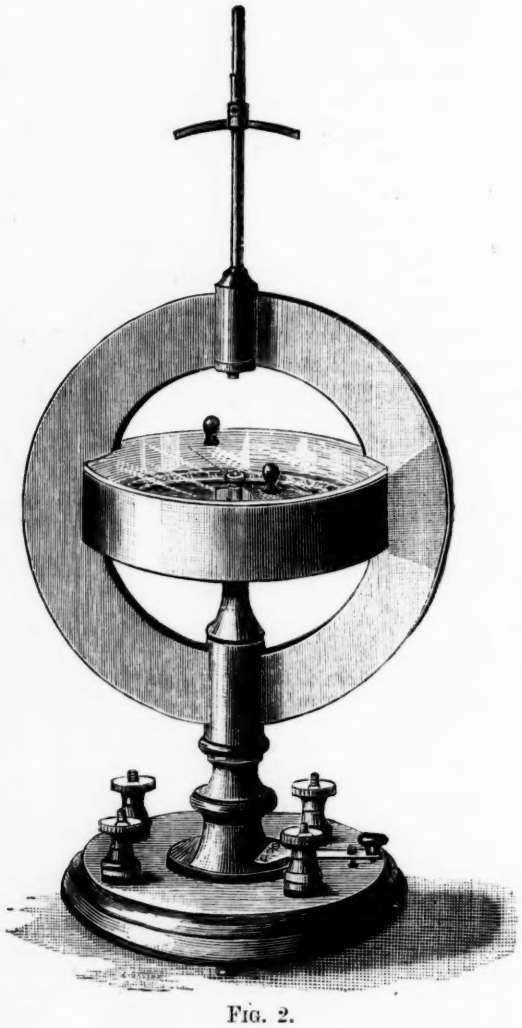


FIG. 2.

solution in the centre chamber has its copper decomposed and deposited on the zinc rod, thus the solution is always kept clear.

When in thoroughly good condition the foregoing cell has an electromotive force of 1·079 volts, but if it is in daily use the power is practically a little less than this, so in the Post Office the value is assumed to be 1·070 as being generally nearer the mark. If a little ordinary care, however, be taken to see that the cell is in good condition, *i.e.*, the zinc plate clean, and the sulphate of zinc solution not too saturated, 1·079 volts may be taken as being correct.

Let us now consider the exact method of making the test for the measurement of current strength.

The first operation is to determine approximately the resistance of the standard Daniell cell; this is done by joining the latter up in circuit with the thick wire terminals of the galvanometer (the latter having been set so that the needle pointer stands exactly at zero), there being in circuit the small set of resistance coils; all the resistance being plugged out, the deflection of the galvanometer needle is carefully noted, and then resistance is added in the circuit by removing plugs from the resistance coils until the deflection is halved, then the resistance unplugged equals the resistance of the battery.

The battery and resistance coils are now connected on to the high resistance terminals of the galvanometer, and sufficient resistance inserted in the resistance coils to produce a *total* resistance in the circuit (galvanometer coil + battery + resistance coils) of 1079 ohms; thus, if the resistance of the battery were found to be 7 ohms, then the resistance in the resistance coils would have to be 72, since we have—

$$1000 + 72 + 7 = 1079,$$

1,000 being the resistance of the galvanometer. The exact deflection obtained must now be observed; if it is found to be excessive, that is to say, if it greatly exceeds 45° (on the *degrees* scale), the sensitiveness of the galvanometer should

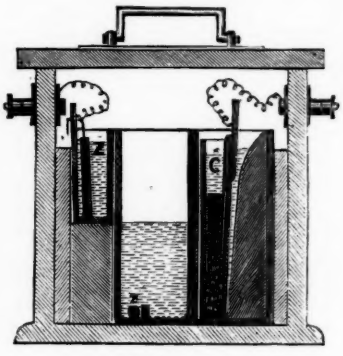


FIG. 3.

be reduced by sliding the adjusting magnet lower down. It is not necessary to be very particular in respect of obtaining the deflection *exactly* at 45°, there is no objection to the deviation being 5 or 6 degrees higher than 45°, but a great excess should be avoided. It is preferable to have the deflection *above* rather than *below* 45°. Of course care must be taken when setting the adjusting magnet to place it so that the needle stands at zero when no current is flowing.

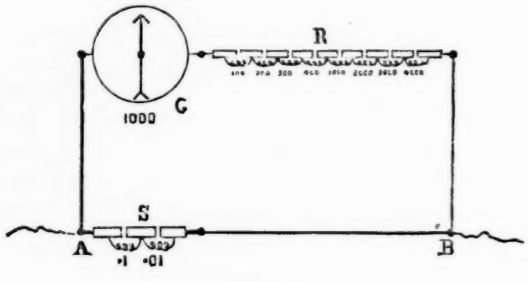


FIG. 1.

Having obtained a satisfactory deflection, the latter should be carefully noted. In doing this it is advisable to attend to the following instructions:—* "If A be the smaller of two contiguous deflections A and B, then if the pointer stands exactly over A the deflection should be called A; if the pointer is nearer to A than to B, then the deflection should be called $A\frac{1}{4}$; if the pointer stands exactly midway between A and B then the deflection should be called $A\frac{1}{2}$; lastly, if the pointer is nearer to B than to A, then the deflection should be called $A\frac{3}{4}$." Thus, for example, the pointer was seen to stand between 51 and 52 divisions, but to be nearer to 52 than to 51; what should the deflection be taken to be? Ans. $51\frac{3}{4}$. By keeping rigidly to these rules we can never make a greater error in reading the

* See "Handbook of Electrical Testing." Second Edition, page 52.

deflection than ¼ of a division. Unless attention is paid to these directions there is always a possibility of a deflection being read too high in one case and too low in another, so that if a comparison has to be made between the two a comparatively large error may be made.

The deflection obtained, as has been before pointed out, is due to a current of 1 milliampère. The standard cell and the small set of resistance coils may now be removed, and the galvanometer joined up with the high resistance coils, R, and the shunts, S, as shown by fig. 1, the whole arrangement being connected, at A and B, in the circuit through which the current flows, whose strength is required. If the current has a strength of between 10 and 100 ampères then the ·1 ohm shunt will require to be inserted.

The resistance coils, R, must now be adjusted until a deflection approximately equal to that obtained with the standard cell is observed; this deflection being accurately noted the current strength flowing in the main circuit is obtained by multiplying the latter deflection, by the resistance of the galvanometer circuit, and also by 10 or 100 according as the ·1 or the ·01 shunt is employed, and then dividing the result by the deflection given by the standard cell multiplied by 1,000.

For example, suppose the deflection observed with the current whose strength was to be determined, was 54½ divisions, the shunt used being ·1 ohm, and there being in the galvanometer circuit a *total* resistance of 8,500 ohms (7,500 + galvanometer coil), and further suppose the deflection with the standard cell to have been 51¼ divisions, then we have,

$$\text{Current flowing in main circuit.} = \frac{54\frac{1}{2} \times 8500 \times 10}{51\frac{1}{4} \times 1000} = 90{\cdot}4 \text{ ampères.}$$

As the accuracy of the results must depend upon the resistances of the shunts, S (fig. 1), being correct, we must consider how the latter can best be made

(*To be continued.*)

THE SUN-LOCOMOTIVE.

(SEDLACEK-WIKULILL SYSTEM.)

IN No. 45 (Nov. 9th, 1881), we published a description of the Sun-locomotive, invented at Leoben in Austria, and afterwards improved by MM. Sedlacek and Wikulill, we announced at the same time that the *Compagnie du Nord* was engaged in adjusting the apparatus of the inventors on one of its express locomotives, and that we should shortly be able to judge at Paris of all the advantages which this new system of lighting offers for the safety of trains at night. The experiment has now been made, and has been attended with remarkable success. The locomotive, No. 2886, chosen for this purpose is of the American type, with fore-wheels attached. The prolongation forms a long wide platform, on which was placed the generator of the current, to which the steam was conducted by means of a long pipe connected with a tap at the back of the boiler. The electric lamp was placed in front of the funnel, as on the locomotive at Leoben.

The Sun-locomotive, thus constructed, travelled on the 1st and the 7th of December between Paris and Dammartin, drawing the ordinary passenger trains. At these interesting experiments, directed by MM. Deleberque and Banderali, at the request of Max de Leber, representative of Austria, who presented to the Company the whole apparatus, were present engineers from all railways, M. Schuckert, the maker of the apparatus actually used, and M. Lemonnier, who will probably construct those eventually used in France. On the 7th of December MM. Guillebot de Nerville and Meissonier, General Inspectors of Mines, as well as all the engineers of the principal French Companies, who were invited to witness the experiments, mounted the locomotive successively to judge of the altogether new luminous effects produced by this light worked at full speed. The fears expressed at first were very quickly forgotten. It had been proposed not to light the lamp until the locomotive had left the station of la Chapelle for fear of interfering with the signals between that point and the Paris station. As a matter of fact, they could have started from the large room for passengers at Paris with the full light, and have returned in the same way, without having given cause for complaint to any of the officials.

On the contrary, the engine driver as well as all the engineers who took part in this trial journey, were unanimous in expressing the feeling of great security which they experienced on this locomotive, the way been perfectly lighted far in front of the train. The locomotive travelled 70 kilometers with every variation of speed, neither the

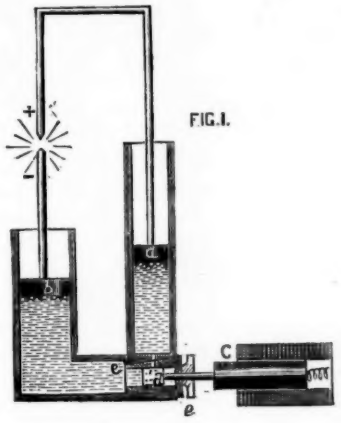


FIG. 1.

generator nor the regulator requiring the least attention, and the light did not vary for a moment. This essential characteristic of the Sedlacek-Wikulill lamp, of being unaffected by the shakes and jerks of the locomotive, depends upon its very simple construction.

Fig. 1 represents a theoretical section of the apparatus. The two carbons are fixed to the rods of two pistons, *a* and *b*, which move in the two arms of a sort of syphon filled with glycerine or oil; the sections of these arms are in the ratio of 1 : 2, so that the movements of the two carbons are

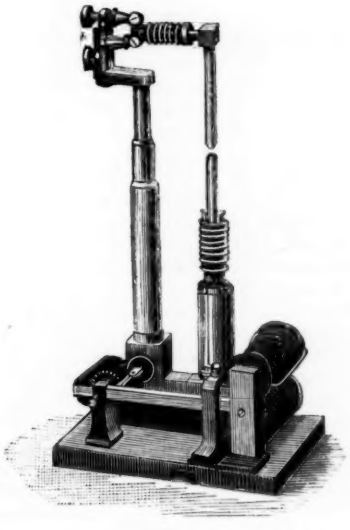


FIG. 2.

as 2 : 1, which corresponds to the rate of consumption of the carbons with continuous currents.

By means of the tap, *e*, we can at will open or close the communication between the two arms of the syphon, and this independently of the little piston, *d*, which closes the hollow centre of the tap and of which we shall speak presently.

Before making the current pass into the lamp in order to obtain the light, we turn on the tap, *e*. The two carbons are then immediately brought into contact, and continue to

touch even after the tap is turned off. In fact the extra pressure which the positive rod had exercised upon the liquid contained under the two pistons is still kept up under the piston, *b*, by the action of a little spring which is continually pressing the core of iron, *c*, that is to say, the little piston, *d*, against the liquid.

This being done let us suppose that the electric current is made to pass into the lamp. Immediately the light is produced between the carbons, and the spirals of the little bobbin which is wound round the core, *c*, forming part of the circuit, the core is attracted into the bobbin for a length which depends upon the spring, which presses it in an opposite direction.

The recoil of the piston, *d*, which follows, makes the piston, *b*, descend sufficiently for the formation of the voltaic arc. It is the mechanism, *d*, *c*, which really constitutes the regulator. It afterwards keeps the voltaic arc at a length corresponding to the intensity of the current, since it acts directly on the negative piston rod, whereas the positive one remains absolutely invariable in consequence of the turning off of the tap, *e*. As the carbons consume, and the little piston, *d*, advances further into the syphon pressed by the spring which gradually overcomes the attraction of the bobbin, *c*, a little vent is opened in *d*, which allowing a little of the liquid inclosed under *a*, in the lower part of the syphon, to pass through, makes the positive piston rod descend, thus bringing the carbons together again. The increase of intensity of the current and the consequent drawing back of the piston, *d*, closing the vent, the arc is brought back to the required length.

Our second diagram represents in perspective the lamp tried on the Northern Railway, such as it is really constructed. The piston, *d*, of fig. 1 is here indicated on the left, and moves vertically to the plane of the syphon. Its rod is fixed in an iron lever which is shown in front of the apparatus. This lever forming the balance of the regulator sustains at the right the armature, the attraction of which causes the recoil of the piston, *d*, and upon its left extremity a spring counteracting this attraction.—*Revue Industrielle*, Dec. 21st, 1881.

THE PRE-ELECTRIC ENGLISH TELEGRAPH.*

BETWEEN London and Portsmouth there are twelve stations, and thirty-one between London and Plymouth, of which eight are part of the Portsmouth line till they separate in the New Forest. Another chain, extending from London to Yarmouth, contains nineteen stations, and another from London to Deal ten stations, making in the whole system sixty-four telegraphs. The distances average about eight miles, yet some of them extend to twelve or fourteen ; and the lines are often increased by circuits for want of commanding heights. In the Yarmouth line particularly the chain makes a considerable detour to the northward. After about twenty years' experience they calculate on about two hundred days on which signals can be transmitted throughout the day, about sixty others on which they can pass only part of the day, or at particular stations, and about one hundred days in which few of the stations are visible to the others. The powers of the stations in this respect are exceedingly various. The station on Putney Heath, communicating with Chelsea, is generally rendered useless during easterly winds by the smoke of London, which fills the valley of the Thames between this spot and Chelsea Hospital, or more commonly between the shorter distance of the Admiralty and Chelsea. Dead flats are found to be universally unfavourable ; and generally stations are useless nearly in the proportion of the miles of dead flat looked over. On the contrary, stations between hill and hill, looking across a valley or series of valleys, are mostly clear, and water surfaces are found to produce fewer obscure days than land in any situation. The period least favourable of the same day is an hour or two before and after the sun's passage of the meridian, particularly on dead levels, when the play of the sun's rays on the rising exhalations renders distinct vision exceedingly obscure. The tranquillity of the morning and evening are ascertained to be the most favourable hours for observation. A message from London to Portsmouth is usually transmitted in about fifteen minutes ; but, by an experiment tried for the purpose, a single signal has been transmitted to Plymouth and back again in three minutes, which by the telegraph route, is at least five hundred miles. In this instance, however, notice had been given to make ready, and every captain was at his post to receive and return the signals. The progress was at the rate of one hundred and seventy miles in a minute, or three miles per second, or three seconds at each station—a rapidity truly wonderful. The English telegraph consists of a large frame in which are placed and worked six shutters, by means of ropes pulled in the manner of bell ropes. The number of signals produced by it is sixty-three—by which are represented the ten digits, the letters of the alphabet, many generic words, and all the numbers which can be expressed by sixty-three variations of the digits. The signals are sufficiently various to express any three or four words in twice as many changes of the shutters.

The observers at these telegraphs are not expected to keep their eye constantly at the glass, but look out every five minutes for the signal to make ready. The telescopes are Dolland's achromatics, which possess no recommendation but their enlarged field and their freedom from prismatic colours in that field : points of no consequence in looking through a fixed and circumscribed object. The field of the Galilean telescope is quite large enough, and, having, instead of the six contained in Dolland's achromatics, but two lenses, one of which is a thin concave, it exhibits the object with greater brightness, and, therefore, ought to have been preferred for this purpose.

It seems strange also that, to ease the operator, it has never been contrived to exhibit the fixed spectrum on the principle of a portable camera, so that, without wearying the eye, the changes of the distant telegraph might have been exhibited on a plane surface, and seen with both eyes, like the leaf of a book.

* This interesting description, which shows how telegraphic communication was kept up before electricity was applied for the purpose, is extracted from a book entitled "Wonders of Nature and Art." Published by William Milner, Halifax, in 1839.

BÜRGIN'S ELECTRIC MOTOR.

WE know that the electric motors which give the best results are those in which the magnetic masses subjected to reversals of polarity are reduced as far as possible, or else those in which the reversals of polarity occur, as in Gramme's ring, continuously, by a regular displacement of the poles on the ring. At the Electrical Exhibition, M. Bürgin, of Basle, exhibited a little electric motor in which there were no magnetic masses at all subjected to reversals of polarity. There was, therefore, no magnetic inertia to overcome, and the motor thus constructed could turn at very great speed. The figures accompanying this description show the principal details in the construction of this motor.

It consists of a core of iron, B (figs. 1 and 2), wound round with wire, M, the convolutions of which are wound so as to complete a sphere. This core of iron turns on a horizontal axis, the wires, M, which are attached to the sections of a commutator, C, are traversed by a continuous current from the source of electricity (a battery or a dynamo-electric machine) and polarise the extremities of the core of iron, B, without reversing the polarities, notwithstanding the rotatory movement of the core.

The sphere formed by this core and the wire, M, turns inside a second sphere which is hollow and fixed, and on which is wound horizontally a second continuous wire attached to two brushes of the commutator, C.

In consequence of the reciprocal reaction which takes place between the fixed sphere, B, and the movable polarised core inside, and in consequence of the reversals of current produced in the outer sphere, a rapid rotatory movement is imparted to the core and its axis.

This motor is characterised by the following points :—

(1.) The movable part consists of an electro-magnet, the polarity of which is never reversed.

(2.) The currents are reversed in the fixed part of the motor, and not in the movable part.

(3.) The movements are produced by the reciprocal

action of a current and an electro-magnet, and not by the mutual attraction exercised by two electro-magnets.

There is, therefore, with this mode of construction, no magnetic inertia to overcome, since the system works without reversing the polarity of the core. It would be interesting to take some tests of this little motor, and find out for

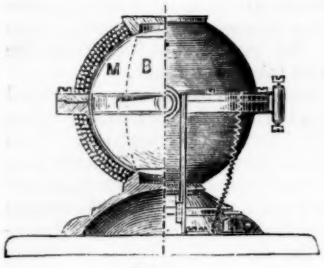


FIG. 1.

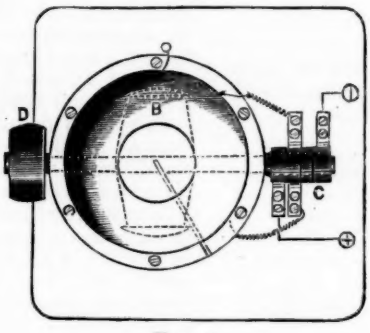


FIG. 3.

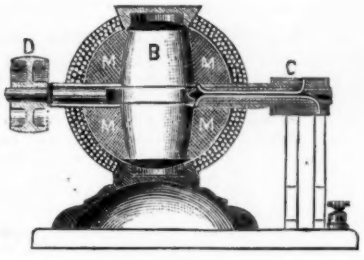


FIG. 2.

certain, what one might believe *a priori*, whether the result would be higher than that given by a double T Siemens' bobbin.

In any case, the model exhibited was simple, compact, and turned at great speed, to the great mystification of the visitors, who could not understand how the movement was produced.—*L'Electricien*, Jan. 1st, 1882.

THE CHEMISTRY OF THE PLANTÉ AND FAURE ACCUMULATORS.

Our excellent contemporary, *Nature*, of January 5th, publishes the following valuable and interesting article on Secondary Batteries, which we believe will throw a new light on accumulators of electricity, and render their action much more easily understood.

PART I.—*Local Action.*

AMONG the important discoveries of late years, few have claimed so much attention, or have been so full of promise for practical use, as the accumulator of Planté and its modifications. Our attention was very naturally directed to the chemical changes that take place in these batteries, especially as it appeared to us that there must be certain analogies between them and some actions which we had previously investigated. In the present communication we propose to treat merely of one point—that of local action, leaving the fuller discussion of the subject to some future occasion.

It is well known that metallic zinc will not decompose water even at 100° C., but we found that zinc, on which copper had been deposited in a spongy condition, was capable of splitting up the molecule even at the ordinary temperature, oxide of zinc being formed and hydrogen liberated. If placed in dilute sulphuric acid, it started a very violent chemical action, sulphate of zinc and hydrogen gas being the result. We termed the two metals thus conjoined, the *copper-zinc couple*, and this agent was fruitful in our hands in bringing about other chemical changes which neither metal singly would effect. Electricians will readily understand the nature of this agent, and will recognise in its effects only a magnified form of what we are all familiar with under the name of *local action*. Now the negative plate of a Planté secondary battery is a sheet of lead, upon which finely divided peroxide of lead is distributed. It is well known that the electromotive force of lead and lead peroxide in dilute sulphuric acid is nearly three times that of zinc and copper in the same liquid. We were therefore induced to think that the plate must act in the same way as our copper-zinc couple. We found such to be the case. If a plate so prepared be immersed in pure water, the decomposition of the liquid manifests itself by the reduction of the puce-coloured peroxide to the yellow monoxide. There could be little doubt therefore that the lead peroxide couple, if we may call it so, would decompose sulphuric acid, with the production of sulphate of lead. This also was found to be the case.

As the destruction of peroxide of lead means so much diminution of the amount of electric energy, it became interesting to obtain some definite knowledge as to the rapidity or extent of this action.

When the peroxide of lead on the metal is very small in quantity, its transformation into the white sulphate goes on perceptibly to the eye, but when the coating is thicker, the time required is, as might be expected, too long for this kind of observation. In one experiment, following the procedure of Planté, we formed the peroxide on the plate by a series of seventeen charges and discharges, or reversals, each operation lasting twenty minutes, and the time was further broken up by seven periods of repose, averaging about twenty-four hours in length. After the last charge we watched the local action taking place, and found that the whole of the peroxide passed into white sulphate within seventeen hours. In another experiment the two plates formed according to Planté's method were immediately joined up with the galvanometer, and deflection noted. They were then at once disconnected. After the repose of one hour they were joined up again, and another observation taken with the galvanometer. This was repeated several times, with the following results :—

Initial strength of current	100
After 1 hour's repose	97
„ 2 „	40
„ 4 „	14
„ 17 „	1·5

It results from this that during each of the long periods of repose recommended by Planté the peroxide on the lead plate is wholly, or almost wholly, destroyed by local action, with the formation of a proportionate amount of sulphate. But this is not, as it would seem at first sight, a useless procedure ; for, in the next stage, the sulphate is reduced by electrolytic hydrogen, and by a process which we hope to explain when discussing the complete history of the reaction, the amount of finely divided lead capable of being peroxidised is increased. That this is actually the case is shown by the following experiment. The peroxide formed on a lead plate by first charging was determined and called unity : it was allowed to remain in a state of repose for eighteen hours, charged a second time, the peroxide again determined, and so on :—

Separate periods of repose.	Charge.	Amount of peroxide.
—	First	1·0
18 hours	Second	1·57
2 days	Third	1·71
4 „	Fourth	2·14
2 „	Fifth	2·43

In other trials, following the procedure of Faure, we employed plates in which the peroxide was formed by the reduction of a layer of red lead (containing 51 grains to one square inch of metallic surface) and subsequently completely peroxidising the spongy metal so produced. In one series of experiments we left the peroxidised plates to themselves

for various periods and determined the amount of sulphate formed. This gave us the amount of peroxide consumed.

Experiment I.	after 2 hours		7·2	per cent.
,, II.	,, 3	,,	15·1	,,
,, III.	,, 4	,,	19·8	,,
,, IV.	,, 5	,,	30·0	,,
,, V.	,, 24	,,	36·3	,,
,, VI.	,, 7 days		58·3	,,
,, VII.	,, 11	,,	67·3	,,
,, VIII.	,, 12	,,	74·3	,,

The last experiment was tested with the galvanometer during its continuance, as in the case of the plate formed by Planté's method, with the following results :—

Initial strengh of current	100
After 1 day's repose	92
,, 3 ,, ,, ...	79
,, 4 ,, ,, ...	34
,, 5 ,, ,, ...	24
,, 7 ,, ,, ...	11
,, 9 ,, ,, ...	8
,, 12 ,, ,, ...	1

It is evident from these observations that a lead-peroxide plate gradually loses its energy by local action, and that the rate varies according to the circumstances of its preparation.

Two difficulties will probably present themselves to any one on first grasping the idea of this local action :—1. Why should a lead plate covered with the peroxide and immersed in dilute sulphuric acid, run down so slowly that it requires many hours or even days before its energy is so seriously reduced as to impair its value for practical purposes ? In the case of the copper-zinc couple immersed in the same acid, though the difference of potential is not so great, a similar amount of chemical change would take place in a few minutes. 2. In a Planté or Faure battery the mass of peroxide which is in contact with the metallic lead plate expends it energy slowly. How comes it to pass that if the same mass of peroxide be brought into connection through the first lead plate with another lead plate at a distance, it expends its energy through the greater length of sulphuric acid in a tenth or a hundredth part of the time ?

The answer to these two questions is doubtless to be found in the formation of the insoluble sulphate of lead, which clogs up the interstices of the peroxide and after a while forms an almost impermeable coating of high resistance between it and the first metallic plate.

The following conclusions seem warranted by the above observations :—

In the Planté or Faure battery local action necessarily takes place on the negative plate, with the production of sulphate of lead.

The formation of this sulphate of lead is absolutely requisite in order that the charge should be retained for a sufficient time to be practically available.

The rapidity of loss during repose will depend upon the closeness of the sulphate of lead and perhaps upon other mechanical conditions. These are doubtless susceptible of great modifications. We do not know how far they are modified in practice, but it is conceivable that still greater improvements may yet be made in this direction.

J. H. GLADSTONE.
ALFRED TRIBE.

PHOTOMETER TESTS OF INCANDESCENT ELECTRIC LAMPS.

MR. ANDREW JAMIESON, the Principal of the Glasgow College of Science and Arts, has lately made a series of tests under the above title, the results of which he has communicated to our contemporary *The Engineer*, and which are published in last week's issue. The lamps experimented upon were all on the incandescent system, viz., Swan's, Maxim's, Edison's, British Electric, and Lane-Fox's. We believe this to be the first lengthy test in which the decrease in the resistance of the carbon filament when made hot is shown. It has of course been known for a considerable time that carbon does decrease in resistance when heated, but we think that many electricians will be surprised to see the great difference between the measurements of a lamp when cold and when working.

Mr. Jamieson's method of measuring the resistances was that of comparing the deflections obtained on a high resistance galvanometer (1000 ohms), placed in a very high resistance circuit, the galvanometer being shunted first by an accurately determined resistance, and secondly by the lamp under test. That this method was accurate enough for all practical purposes is shown by the very slight variation existing between the resistance of some cold lamps measured as stated, and the results obtained from the "Wheatstone's Bridge" test taken as a check.

In a test of five Swan lamps the resistances cold varied from 55 to 73 ohms, when burning, from 31 to 33·5 ohms, the difference of resistance between cold lamps and those giving a light of about nine candles being 46 to 54 per cent.

The electromotive force measured between the terminals of each lamp averaged 39·5 volts, and the current strength in ampères 1·25, the total number of candles per horse-power being about 130. In three other lamps giving an average resistance of 27 ohms when hot, and having passing through each of them 1·6 ampères, produced by an electromotive force of 44·5 volts, the candle-power per horse-power reached an average of 185.

The remaining results on Swan's lamps are confined to observations of the length of time they will practically last in working order for mining purposes, and the average life of such a lamp, giving a candle-power of about 6·5, appears to be from 600 to 650 hours. Mr. Jamieson is of opinion that the increased length of life which can now be got out of a Swan lamp, when used at such a low candle-power, will outweigh the increased economy in power obtained by using them at a higher temperature. This may probably be so for the special purpose of the lamps from whence Mr. Jamieson derived his figures, but not for general lighting. We believe that incandescent metals would give much more economical results, even if the illuminating power of each lamp was reduced below six candles. The Maxim lamps have on the average a slightly lower resistance when cold than those of Swan, and the decrease in resistance when heated to about 25 candle-power, which requires in each lamp an electromotive force of 60 volts, and a current strength of 2 ampères, varies from 35 to 45 per cent. The Edison, British Electric, and Lane-Fox lamps tested, had a resistance when cold varying from 100 to 180 , and the decrease in resistance of all these lamps, when heated to about 10 candle-power, is from 60 to 70 per cent.

Mr. Jamieson uses Rumford's method of measuring the intensities of the lamps which he finds admirably adapted for the purpose when testing up to 20 candle-power. The paper is illustrated with a diagram of the means adopted by Mr. Jamieson for obtaining all his results, and we hope it will soon be followed by still more exhaustive experiments. We would suggest that the resistances of lamps should be experimentally determined when giving a light of 5, 10, 15, 20 candle-power, and so on.

Altogether, the paper forms a subject of information and interest to electricians generally, and more especially to those engaged in perfecting the various systems of incandescent lighting by electricity.

RECENT WONDERS OF ELECTRICITY.

By W. H. PREECE, F.R.S.

Delivered before the Society of Arts, on Wednesday evening, 28th December, 1881.

LECTURE I.

I OUGHT to commence, if I carried out the customary practice, by addressing the audience as ladies and gentlemen, but to-night I much prefer commencing with boys and girls, because the two lectures that I am about to deliver to you are really intended to be addressed to the youngest members of the Society. I would first direct your attention to the fact that this hall is illuminated by electricity, and although I do not intend in any way to refer to the electric light to-night, it is my intention, step by step, to lead you up to it,

so that when we part this day week, I hope and trust to be able to let you depart with a thorough and complete knowledge how electricity works and how it produces these marvellous effects. To accomplish this object there are two things most essential; the first is, that I, your lecturer, should be perfectly clear in my definitions, and simple in the language I use; the second is, that you should devote to me your very earnest and best attention, and strive all you can, by thought afterwards, to understand what I mean. I shall use, doubtless, unconsciously, a great many words that are new to you, but which are to me just as familiar as household words, I will, however, try to explain them, and endeavour if I can, to let those words impart to you the very idea that they conjure up in in my mind. At the commencement, there are two words in very common use that many of you have heard over and over again, but which convey in the way I shall use them, perhaps a different conception. These two words are "work" and "energy." I can readily imagine that one of you boys may say when I call your attention to the words "work" and "energy;" "Why, what nonsense to talk to me about work; have I not been working as hard as ever I can during the past term to gain a prize, and have not I exercised all the energy I possess to distinguish myself in my class?" But the words "work" and "energy" applied in that sense are applied in a mental sense, and not at all in the physical sense in which I shall use them. Now, I daresay many of you live in town; some may live in the country; but whether you live in town or country, you all know what a garden is, and what a gardener does. Suppose a gardener, with a ton of gravel in front of him, were told to move that gravel to a height of three feet. He would go to work with his spade; he would move shovel-full after shovel-full from the ground line up to the three feet height, and after he had moved the whole of it you might readily imagine that he would be a little fatigued. Now, whenever a person does anything which causes fatigue, he does what we call work. The gardener, in lifting the gravel, would perform an amount of work which is capable of being measured. I will give you another illustration. Supposing some of you boys were put beside a pile of cricket balls, and for a wager or prize you were called upon to throw the balls as fast and as far as you could. A good thrower would perhaps throw the first ball 80 yards, he would throw the second ball 75 yards, the third 70 yards, the fourth 65 yards, and so each ball that he threw would go a less and less distance, until he had no strength left, and he could throw no more balls. Now, that boy would have done work; something would have passed out of him into the balls; he has, as it were, passed something that belonged to him into the cricket balls, and as a result he feels fatigue through the loss of this something. Take another illustration: Supposing two crews agree to row a race. They start full of life and full of energy; they pull with all their hearts and might and arrive at the goal, in common language, thoroughly pumped out. Something has gone out of them into the boat. That which has gone out of the crew, and out of the boy who threw the cricket balls, is what we call energy, and what they have done is to do work upon the boat. Another example is in the case of football. A boy kicks a football and makes a splendid goal. To do that he has sent something out of his body into the ball which hurtles through the air past the goal, and the game is won. In all these illustrations something is done which results in fatigue, work is performed and energy is lost; in fact, work done means energy applied, and energy applied means work done. As mental energy is our capacity for learning lessons, for going through examinations, and that kind of thing, so the energy of the kind I speak of is the capacity for doing absolute physical work. The generality of this energy is immense. It is a difficult thing to grasp the fact that there is something in existence that we cannot feel, that we cannot touch, and that we cannot see, but which gives us all the force and all the power we possess. The earth as it moves around the sun, and the earth as it daily rotates upon its own axis, are instances of the existence of this energy; in fact, every kind of change produced in the condition of matter, whether it be in its physical state or in its position with reference to fixed objects, means energy gained or energy lost. The energy gained or lost is the quantity of work done on a body, or done by that body; so I want you to grasp, if you possibly can, the fact that every case of motion on this earth—even the sound of my voice, as I now speak to you—is due to the exercise of this particular energy. Lecturing, for instance, is a considerable exercise of energy. A man can lecture pretty well for an hour; he can lecture not quite so well for two hours, but the best lecturer in the world can scarcely keep at it for three hours without losing all his energy, and, like the crew in the boat, being thoroughly pumped out. This energy—or work done, as I have said—is measurable. The gardener who moves his ton of gravel three feet high has done an amount of work that any boy can calculate who will reduce one ton to pounds, and multiply that sum by three. He will then have obtained 6,720—what we call foot-pounds. One pound, raised one foot high, is the common and ordinary unit of work; 33,000 pounds, moved one foot high, is called a horse-power, and the horse-power is the mode by which the power of steam-engines is measured. One steam-engine is known from another by its being able to exercise 10, 20, or 50 horse-power; and so, whether it is merely the lifting of gravel—or a small tube, such as I have here—throwing a cricket-ball, moving a boat, or working a steam-engine, it can all be measured by this simple unit of foot-pounds. Two other terms are necessary, in order to make you comprehend what energy is. Energy is found in two conditions—called "potential" from its position, and "kinetic" from its motion. The potential form of energy is that which exists in the form of a wound-up watch-spring: you wind up the spring of your watch, and by doing so, you pass something from your body into it—you transfer energy from your own body into the watch, the spring is wound up, and the watch thereby can be kept going for twenty-four hours or more from the storage of energy imparted to it. A clock, again, will go for eight or fourteen days by your winding up the weight until you impart to the clock energy, in this potential form, of sufficient power to keep a clock going for a fortnight. In gunpowder there exists a splendid example of the storage of energy. It remains quiescent until heat is applied, when its potential form of energy is at once transformed into its active or kinetic form, impelling a cannon ball, or bullet, with tremendous force. Coal, again, is a grand store of energy. All our steam engines employed in manufactures are set going by the energy that is stored up in coal. This energy has remained stored up in coal for millions of years in the bowels of the earth, it is brought to the surface, and is there used to produce power in the innumerable ways with which you are acquainted. Take food; I had a very good chop just now; that supplied me with a store of energy, which will enable me for one hour at least to talk to you, and had I not had that chop, I do not think I could have talked to you for more than half-an-hour, instead of the three-quarters more that I hope I may yet be able to get through. I have given instances of energy in its potential form. We will now take one or two instances of it in its kinetic form, that is, when it is in a state of motion. A moving cricket-ball is a good example of kinetic energy. In its passage through the air it possesses kinetic energy, and should the ball catch you head you know pretty well what is the effect. A steamship moving and a running railway train are kept in motion by the energy imparted to them from coal, and we know what tremendous energy a steamship or a railway train has, as when a collision occurs there is a terrific smash up. Our earth is another magnificent store of energy in its rotation every 24 hours; a portion of this energy it gives up in the shape of tides. Our tides abstract energy from the earth which is gradually robbing the earth of its motion, and the result is that our day is getting longer and longer. If any of you live a million years you will probably find that the day will be a minute longer than it is now!

Such being the two general forms of energy, I want next to give you two or three ideas of the forms in which this mysterious energy appears. I had intended to bring a familiar toy, a humming top, before you to show you the energy it contained when spinning; but we have other illustrations of various kinds. Take a piece of a very dangerous material called sodium, a beautiful white metal, of which I have a quantity in a bottle here, put it on a piece of blotting paper, and then place it on top of the water contained in this glass vase; you will see that the sodium possesses energy in itself in a potential form. The moment it is brought in contact with the water, the oxygen of the

water unites with the sodium, and produces the effects of heat, light, and sound, the result of the chemical energy of the sodium in its potential form being brought into the active or kinetic form by mere contact with the water. Another instance. Here is the dome of a bell, which I strike with a mallet or hammer, and thereby impart energy to it, and it sets the whole air of this room in motion, and the tympanum of every ear present is struck by the little bullets of air that are thrown into vibration, and the result is the effect called sound. As another illustration, I will take coal. I take a small piece of coal and warm it in an iron cup, so as to cause it to give out a little kinetic energy in the shape of heat, and on placing it in this jar of oxygen [experiment performed], you see that the mere insertion of coal, so heated, in an atmosphere of oxygen, produces a most brilliant effect, which is the result of the conversion of the potential energy existing in the carbon, or coal, into the kinetic energy seen in the shape of motion, heat, and light. We have even more brilliant effect of this conversion of potential into kinetic energy. Here is a piece of magnesium wire which, when heated [light applied] has its potential energy converted into kinetic energy, and a most brilliant light is the result. But we need not go to light, and we need not go to heat, for instances of energy. I have shown you that energy is a form of motion, that it is so found in sound, heat, and light, but we also have energy as magnetism. There is a little toy duck floating on the basin of water before me, and I merely hold in front of it a magnet, when you will see that a sort of affection is set up between the duck and the magnet, by the duck following the motion of the magnet round the basin. That is another form of energy. The last form of energy that I wish to draw your special attention to, is that due to electricity. You have all seen the vivid flashes of lightning and have heard the dreadful roar of thunder; in these two effects we have energy. It is in its potential form when it exists in a charged cloud, and in its kinetic form, when that charged cloud gives its charge up to the earth, and in flying to the earth produces that dreadful effect that we call lightning, with its accompaniment, the roar of thunder. Thus, you have illustrations of energy in its different forms, electrical, magnetical, chemical, heat, light, and motion.

Now comes the question—how is this energy transferred from place to place? You may have all stood upon the sea beach and have seen the waves dashing upon the rocks, and sent up in the air in white and brilliant spray. You have seen the waves rolling over and over again in glorious breakers upon the sands. You have probably seen wrecks dashed to pieces by the force of waves, all which effects are the result of energy which has been imparted to the water by a storm miles and miles away, the energy of that storm having been transferred by the waves of the water till it meets with the resistance of the shore, and produces those effects I have mentioned. Again, energy is transferred by air vibrations. The explosion of a gun can be heard to a distance of 20 to 25 miles; and instances are known where the bombardment of a town has been heard at a distance of 100 miles. It is well known that the roar of the cannon at Waterloo was heard on the English coasts, at a distance of over 100 miles. Again, we have energy transferred from the sun to the earth by that thin, almost immaterial, subtle, medium, called the ether, by means of which we have motion transferred from the sun to the earth, which gives us at one moment light, at another moment heat, and at a third moment those effects that result in photographs. Energy is also transferred through matter in the shape of heat. I touch the lamps before me, and feel them warm because the heat of the incandescent material which they contain has thrown the molecules of the covering glass into vibration, and that vibration imparts a vibration to my hand that gives the sensation of heat; and if I were to put a poker in the fire—which, no doubt, all of you have done—it would be found, in a very short time, that the heat of the fire had been transferred through the poker to your hand. Electric currents are a form of energy which is driven through matter. Electricity is transferred, principally, through metals; some of them transfer it with great alacrity—for instance, silver and copper. There are, on the other hand, materials such as dry wood, glass, gutta-percha, india-rubber, and such like, that scarcely will allow any electrical energy whatever to pass through them; and the result is that bodies are divided into two classes, the one called *conductors*, that conduct electricity away, and the other called *insulators*, which prevent electricity from being conducted away. If you have noticed the telegraph wires passing through the country, you will have seen that they are suspended on little earthenware knobs (there are specimens of the various kinds in use on the table for inspection), which are employed because they resist the passage of the electrical energy through them; and, consequently, the electrical energy must flow through the wire which they suspend to the distant end, where it is wanted to do work and produce desired effects.

We have now to consider the motive agency. I ought to have said at the first starting, as every boy fresh from school will know, *ex nihilo nihil fit*, from nothing nothing is created, and therefore there can be no effect without its cause. There can be no wind without a difference of pressure in the atmosphere to cause motion of the air. At the present moment I can feel a draught, which is due to a higher pressure above and a lower pressure below on the other side of the door, and the air is circulating over my head from the higher to the lower pressure. The chimney draughts are produced in a similar manner. Why are meteorologists able to tell us that there is a gale coming? Because they know that there is a higher pressure at one spot than there is on another; and where there is a difference of pressure there must be a motion of air. So with water at different levels. The tendency is to produce a common level, and the passage of water from the higher to the lower level produces motion and energy. Tides are simply the result of the effort to produce equilibrium in the sea after it has been attracted in different directions by the force of the sun or the moon. Rivers flow because the water high up in the mountains is at a higher level than the ocean, and the purpose of their flowing is to produce equilibrium, or an equality of level. Heat circulates in our rooms because a higher temperature exists in the fire than in the walls. In the electric lamps before me there is a very high temperature, because the carbon is maintained in a very high state of incandescence, and on the approach of my hand, which is of a lower temperature, towards the lamp, instantly there is a passage of heat from the high to the low temperature, and I feel that heat striking my hand exactly in the same way that I feel the draught (before mentioned) on my shoulders. Lastly, take electricity. We cannot speak of the level of electricity; we cannot speak of the pressure of electricity, in the same sense that we can speak of the pressure of liquids. We cannot speak of the temperature of electricity; but there is a peculiar condition of electricity analogous to all three, analogous to pressure, temperature, and level, and that peculiar quality or condition is called *potential*. When we speak of electricity of a high potential, it has exactly the same meaning as high level of water, or of high temperature, and wherever two differences of potential are produced, separated by a conductor, electricity flows. Having said so much, perhaps too much, I want to speak to you about the production of electricity. Having shown you the various forms of energy, how it is transferred, and why it is transferred, I want now, to say something of the production of electricity. You know very well that a lump of coal is a store of energy; that is evident by placing it in the fire. There are certain contrivances by which electricity can be produced from coal, but the effects are difficult to show to an audience. So we will take zinc which, for the purpose, is better than coal. Zinc is a grand store of energy in its potential form. Here is a piece which I take up and place in a glass jar, and in that same glass jar I put a piece of carbon. I then place water in the jar, and if I added to the water a little sulphuric acid, I should produce a galvanic battery; there would be a difference of potential, of which I just spoke, between the zinc and the carbon, which leads to the production of a current of electricity when the zinc and carbon are joined by a conductor. I have 40 of these cells, or a battery, downstairs, and I have two wires connected with its two ends, now in my hands. I know my battery is all right because, you see, when I bring the ends of the wire into contact with each other sparks are produced, which show that electricity is passing. I will not explain those sparks to you to-day, because I wish to talk to you about electro-magnetic effects of electricity and how they are utilised. The first is the production of magnetism. I have here an electro-magnet, which is simply a bar of iron enveloped by an insulated

copper wire, and a poker. A poker can be utilised for a great many purposes, but my present purpose is to place it on the large electro-magnet before you. So long as the battery wires are not joined to the wire around the electro-magnet, and, consequently, no current is passing, you see that I can raise the poker from its position without difficulty; but, now I join on the wires connected with the battery to the coil of the electro-magnet, the poker is attracted with greater force than my strength can overcome. The effect is more perceptible by the use of nails instead of the poker. When the current is on you see that, owing to the attraction of the nails by the magnet, I am able to build up an ornamental triumphal arch of nails, but directly I take off the current, the magnetism ceases, and the nails succumb to the force of gravity, and fall to the floor. I have here the parts of an electro-magnet disjointed, which I will put together to illustrate the utility of this power of attraction. I place the iron bar surrounded with wire on the table, and on holding nails to it, you see it possesses no attractive power. If I let the current pass from the battery through the coil, the iron is magnetised, the attractive action is immediately set up, and the nails are attracted. Now, suppose I want to utilise this power to ring this bell—the dome which I struck a short time ago—I place the hammer (which is attached to a piece of iron in position to be attracted, like the nails, so as to imitate the motion of my wrist) in front of the electro-magnet; I then place the bell-dome on its rod, so that the hammer, when drawn forward, will fall upon it; and, as you will see, the arrangement is complete in that simple form, for each time a current is sent, the iron armature is attracted by the magnet bringing with it the hammer which strikes the bell by its forward motion. This is the principle on which all electric bells are constructed. A similar arrangement is employed for giving alarms in case of burglary. A small switch arrangement is attached to the framework of the bedroom door [a small door so fitted was exhibited]; this switch is put on on going to bed, and should the door be opened by any one during the night, a succession of currents of electricity are sent to a bell, which continues to ring till attended to, and it would be a bold burglar who dared to carry on his nefarious business under such a din. A modification of this arrangement can be adapted to innumerable purposes. In America, where servants are not so plentiful as in England, necessity has compelled the employment of electricity for domestic purposes to a far greater extent than in England. In nearly every town in America, systems of wires extend to almost every house, in the hall of which is a small instrument [one was exhibited], on the dial of which divisions bear the various words—messenger, carriage, coupé, express waggon, doctor, police, fire, and two or three other things, and on turning the instrument pointer to any division, and drawing down a spring, a call is sent to the central office or bureau, and the instrument there indicates the service required and at what house, and the request is carried out at once. While travelling in America, I was once afraid that I should not have time to reach the nearest telegraph-office, to despatch a telegram in reference to an appointment; and on mentioning my difficulty to the lady in whose house I happened to be, she set her little instrument to "messenger," sent the current by pulling down the spring, and in two minutes a messenger was at the door waiting to convey my message to the telegraph office. Time passes terribly quick, and my energy is gradually disappearing, so that I shall have to pass over some of the things I wanted to show you, such as the process of engraving by the electro-magnetic system; how toys were moved, boats made to swim about, and birds to sing.

(*To be continued.*)

UNSCIENTIFIC ELECTRIC LIGHTING.

THE present success of the electric light has been achieved more by the carefully considered details of the apparatus employed therein, than by any special knowledge of electrical science on the part of those who have hitherto carried on this new industry. This is a good augury for the future prospects of lighting by means of electricity, for machines and lamps are now so well and simply constructed, and have so little about them requiring technical training for properly understanding their working, that small private installations may safely be left in the hands of any person of ordinary intelligence.

Still, with all the success which has attended nearly all the applications of electric lighting, there have been some great failures which must have a marked effect on its progress, and as these unfortunate drawbacks have occurred in the very places where success was most to be desired, we can but think that the failures were due to those entrusted to take charge of the operations. The two most important trials of recent date resulting in a non-success are those of the Brush Company at Edinburgh, and the British Electric Light Company at Liverpool, where in each case the town authorities have decided against the use of the electric light. In both cities the wires conveying the electric current have been stretched from lamp to lamp overhead, and the reason urged by the contractors to account for the failure of their systems is much the same in each instance.

At Edinburgh the wires were said to be affected by the wind to such an extent that their shaking put the lamps out of adjustment. At Liverpool the standards upon which the lamps were erected were not sufficiently strong to support the conductors, and the Company declared that to carry out their contract it would be necessary to grant them another year, with the condition that they should be allowed to carry their wires underground. The Town Council not seeing their way clear to agree to the Company's terms, this important experiment falls to the ground, incurring great pecuniary loss to the contractors.

We have in a note made some remarks on the faults which were allowed to appear in the Edinburgh trials. It is much to be feared that the majority of those engaged in the installation of the electric light know but very little of the elements, and still less of the higher development of electrical science. Electric lighting being but of the last 4 years' growth, it can hardly be expected that everything concerning it is yet known even to those who have made electricity their profession. But professional electricians would at least understand the force they were dealing with, and know where and how a failure would be most likely to occur.

There are but few such men engaged in this important occupation, and those who are now intrusted to carry on the work are with but rare exceptions men who knew nothing whatever of electrical matters, until by force of circumstances they were thrown into their present positions. Any man who puts up an installation of the electric light, now calls himself an electric light engineer, and those also who have not yet got to this degree of proficiency, but who advertise themselves as being ready to do so. Within their province they have to deal with such terms as electromotive force, current strength, resistance, circuits of lamps in series, and parallel, &c. How many of the so-called electric light engineers have anything beyond a vague idea of the meaning of these terms when explained to them in technical language by others whose knowledge is not much more extensive. Taking electromotive force as an example, we have seldom known any experiment tried without the greatest ignorance of high tension currents being shown. Those whose systems depend for their successful working upon machines giving high tension currents seem scarcely yet alive to the fact that to keep such electricity within bounds requires insulation beyond what they choose to give it. Innumerable instances of failures from this want of insulation have cropped up, and so it will go on for a time until electric lighting companies engage professional and competent electricians to, at least, superintend their operations.

Any one who has ever been engaged in testing submarine cables will best appreciate the difficulties to be contended with in securing good and complete insulation, and if he has ever experienced a shock from a battery of 500 volts or so he would not leave anything undone to secure immunity from the results to be feared if by accident one should come in contact with a wire belonging to a machine capable of producing twice or three times that tension. At present ordinary precautions are neglected, and death, in some instances, has been the penalty. Electric light companies seem to leave too much licence in the hands of their managers, who, as a rule, are not electricians at all, or even electric light engineers, and the result is that large

contracts are secured without a moment's consideration of how the work is to be performed, or whether the time allowed is sufficient for properly carrying out the necessary details. We have known several instances of electricians of great experience (not only in the generally understood branches of the profession, but in electric lighting matters particularly) when seeking employment, have such remarks as the following made to them:—"We do not require electricians to do our work, what we seek are engine-drivers and stokers, who can do all we want."

Again, in respect to the technical knowledge of the machines and apparatus dealt with, electric light engineers are as a rule quite ignorant of their electrical conditions, and it is rarely that one comes across any testing apparatus in connection with the manufacture and experimental trials of anything appertaining to the system that may be employed. Perhaps in most cases testing instruments beyond an ordinary detector would be valueless, as to use such accurately, requires special training and skill. But it is much to be deplored that more scientific knowledge is not brought to bear upon the practical application of the light of the future. There are of course honourable exceptions to the somewhat low standard of knowledge with which we have credited the practical electric light engineer, but in most cases this is due to early professional electrical training.

If we take the firm of Messrs. Siemens Brothers as an example, we have here the professional electrician to superintend every detail, for it must be remembered that Messrs. Siemens have devoted their lives to the object of attaining all the knowledge that it is possible to arrive at in electrical matters, and they have succeeded, perhaps, beyond all competitors in scientific electric lighting, although others may have been more successful in popular estimation and in a pecuniary point of view.

Had such a firm made a large installation of electric-lighting in any city in which it was necessary to use overhead wires, we venture to say that the lamp posts would have been calculated to stand the strain of the suspended wires, and that all the details of such work would have been overlooked by one competent to decide as to the best method of operating to adopt.

We are sorry that two such important places as Liverpool (the very centre of shipping interests), and Edinburgh, should have found it desirable to discontinue the experiments which ought to have been the means of enormously extending the future lighting of towns by electricity. However, we do not fear but that in the end the directing of such operations will gradually be obtained by professional electricians, and if any technical points, now but vaguely understood by many electric light engineers, can be cleared up by the series of articles on the subject now appearing in our pages, we shall feel great satisfaction in drawing the attention of all concerned to the fact that electric-lighting to be perfectly successful must not be worked at so much in the dark, but that at least an elementary knowledge of electricity and magnetism, and the laws of currents, is necessary to enable the electric light engineer to meet the demands of the public.

NOTES.

ELECTRIC LIGHTING OF LIBRARIES.—The project of introducing the electric light into the libraries of the Athenæum and the Reform Clubs is now under the consideration of the committees of both, and the Royal Institution is to be lit up with the electric light every Friday evening.

THE ELECTRIC LIGHT IN EDINBURGH.—With last night came the termination of the contract between the Town Council and the Anglo-American Brush Company for the lighting of Princes Street and the bridges with the electric light, and the lamps were to be at an early hour this morning extinguished, not for the present at least to be lit again. During the past week the whole apparatus for the production and distribution of the electricity was overhauled by one of the Company's most experienced electricians recently arrived in this country. Several important leakages were, we believe, discovered; and the effect of these having been put right was observable in an additional brilliancy and steadiness in the light, which has probably never been seen to better advantage than it was last night. To many the stoppage of the light after its four months' trial will no doubt be matter of regret. The Corporation, however, chiefly, it is understood, on the ground of expense, have not seen their way to continue it longer on the present footing.—*Scotsman*, Jan. 4th.

The Brush Company has, however, offered to light Princes Street as cheaply as the Bray gas light could be furnished, but notwithstanding this, the Town Council of that city have decided that their contract with the Brush Company should not be resumed, consequently on the 3rd inst. Edinburgh returned to its former condition. This appears to be a backward movement, and we fancy the electricians of the Brush Company cannot be held blameless for the very unsatisfactory trial. We feel sure that had greater attention been given to securing proper insulation for the conductors when erected, and the regulation of the lamps, an excuse such as "the flickering of the lamps is caused by the shaking of the wires by the wind and consequent derangement of the apparatus" would have been unnecessary.

It is true that the wind in some cases broke the circuit, but this defect ought never to have occurred with sufficiently strong conductors and proper joints. The Jablochkoff system on the Thames Embankment was for a long time worked with the wires stretched from lamp to lamp, but the shaking of the wires did not disturb the lights in any one instance.

The fact of the current also making earth through lamp posts ought to have been guarded against, and we can only hope that at an early day the Town Council of Edinburgh may reconsider their decision and make further experiments either with the Brush or other systems. We very much fear that the electricians of the Brush Company do not seriously consider what the electromotive force of their large machines really means, for this breaking down of the insulation is of frequent occurrence, and they should surely be aware that the conductors, when used for their largest machines, must be better protected than those used with smaller machines giving less tension. The question of insulation when using high tension currents has not been sufficiently taken heed of in regard to electric lighting, but it is one of the utmost importance to the successful working of a number of arc lamps on one circuit.

ANGLO-AMERICAN BRUSH ELECTRIC LIGHT CORPORATION LIMITED.—At a meeting of the directors held on the 11th inst. at the offices of the corporation, Sir H. W. Tyler, M.P., in the chair, the directors decided, on the accounts which were placed before them, duly audited, to recommend to the proprietors a payment out of manufacturing profits of a dividend at the rate of 12½ per cent. for the year ending December 31st, 1881, writing off all preliminary expenses, 10 per cent. depreciation on all plant and machinery, and carrying forward a balance of £2,934 18s. 9d. to next year. They also transferred the sum of £99,500 to a reserve fund which has been realised by sales of patents, concessions, and licences.

THE ELECTRIC LIGHT IN VIENNA.—On the 3rd inst. a portion of Vienna, including the Graben and the St. Stephen's Platz, was lighted up with electricity. The system applied was the Brush. The lights were not very effective, owing to the employment of an engine of insufficient power. The experiment, with an improved engine, is to be continued for a month.

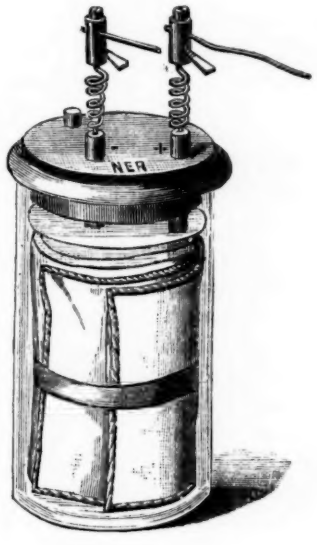
ELECTRIC LIGHTING IN PARIS.—A scheme is on foot, having been approved by the Municipal Council of Paris, for extensively lighting with electricity the quarters of the Prefecture of the Seine, in the Tuileries. It is the work of M. Cernesson, and comprises lighting the Salle des Séances with eighty Swan lamps (in place of eighty Carcel lamps), and six Siemens' arc-lamps; lighting the library with forty-eight Maxim incandescent lamps (on the present lustres); another room with twenty-four Lane-Fox incandescent lamps; another with twenty Swan lamps; the Salle des Pas Perdus with two Werdermann lamps; a lobby with two Siemens' lamps, and a staircase with four Brush lamps. The whole will require an outlay of 75,000 francs. The horse-power necessary is forty-four, and while the idea of obtaining this from the Seine has been considered, it has been decided to set up a gas-engine in the court of the Tuileries. A portion of the motor force is to be employed for electric hoists, for driving ventilators, and other uses.—*Nature*, Jan. 5th.

DISTRIBUTION OF MOTIVE POWER.—A very strong (at least financially speaking) company is being floated in Paris for the purpose of establishing centres to produce electric currents and distribute them to subscribers at their own houses, or works, to be used by them as sources of mechanical force. The Gramme machine is the one to be used for producing the current, which is to be distributed over the city upon the plan devised by Monsieur Marcel Deprez. The company is being brought out by the Union Générale, just now one of the most prosperous financial establishments in the French capital, Messieurs Gramme, Fontaine, Deprez, and A. Niaudet are on the Board of management. The practical development of this idea will be watched with great interest, and there is no apparent reason why, if it is carried on in a commercial way, and not killed by over financing, it should not result in a success.

ELECTRIC FIRE ALARMS.—We understand that the telegraph service attached to the Paris Fire Brigade is shortly to undergo important modifications and receive material development. It is evident that there is ample room for improvement, for as now organised the central station cannot possibly meet the requirements of an efficient service. Although there are some twenty-four line wires running into it, there are only four receiving instruments, each of which has consequently to work six circuits; the result is that when occupied on any one of them, all calls that arrive by the other five (no matter how important) have to wait their turn for answer. This is a very inadequate state of things for a large city like Paris, where the distances are great and warnings of outbreak of fire should be communicated to the Brigade's head-quarters with all possible despatch. It is contemplated to put a receiving instrument to each wire, and to proportionately increase the staff of clerks on duty, of whom there are only at present five to work the twenty-four wires.

NEW CABLE.—The India-rubber, Gutta-percha, and Telegraph Works Company have contracted to supply the French Government with 150 nautical miles of submarine telegraph cable. The French cable transport *Charente* will be sent from Toulon, to receive the cable on board, off the moorings at Silvertown. La Seyne, near Toulon, is the headquarters of the submarine telegraph department of the Ministry of Posts and Telegraphs, and is under the direction of M. G. Amiot, ingénieur chef du service des câbles sous-marins. The India-rubber Company are now erecting there two cable machines, which were made in the works at Silvertown.

NEW ARRANGEMENT OF THE ACCUMULATOR.—We have already stated that in consequence of arrangements concluded with the Force and Light Company, M. E. Reynier became actual manufacturer of the accumulators with red lead. The Faure accumulators, after having been made up of plates coiled into a spiral, were arranged in troughs with plates placed parallel to each other side by side, two arrangements adopted successively by M. Planté; but a re-transformation took place in the end in the arrangement of these piles, for, like M. Planté, we have now returned to the first method which, thanks to the care bestowed by M. Reynier on the manufacture of these couples, gives better results. M. Reynier, in fact, having found that in almost



all the couples constructed up to the present there existed between the plates contacts which gave rise to local currents liable to deteriorate them, and having also ascertained that the coverings or felt rotted after being a certain time in action, was led to substitute for felt a special material, a kind of woollen serge, which in a great number of experiments tried by him for several months has given good results as to durability, and it is with this stuff that he covers the sheets of lead of his couples after they have been coated over with the layer of red lead, which is requisite in order to form the rough deposit of lead necessary to the formation of the current. He also returns, and rightly, to the glass jars for inclosing the spirals of lead, which enable him to see, without disarranging anything, the effects produced in the couple, and consequently to ascertain its degree of insulation. It is certain that if the couple

presents abnormal contacts, gases will be given off under the influence of the accumulated charges, but if nothing is given off after the couple has once been charged, we may conclude that the pile is in good condition as to insulation. Besides the ebullition of gas in a well-made pile of this kind, allows us to see, at the moment of charging, when the electric action ought to be suspended ; in fact, as long as no gas is produced on the electro-positive sheet, we may continue to charge, for all the oxygen freed is used in oxidising the lead, and it is only when this oxidation is complete that the gas is forced to escape. In the first piles of this kind, this giving-off of gas was often continuous, and one could therefore conclude that their construction was imperfect, and it was for this reason that M. Reynier decided to modify them. The drawing which accompanies this note will give some idea of the new arrangement.—*La Lumière Electrique*, Dec. 28th, 1881.

PROPORTION TO BE ESTABLISHED BETWEEN THE POWER AND THE RESISTANCE IN ORDER TO OBTAIN FROM THE ELECTRIC CURRENT A DESIRED EFFECT.—Every one knows the induction apparatus of Pixii, Clarke, &c. They consist essentially in making an electro-magnet, or an induction coil arranged as an electro-magnet, revolve before a magnetised horse-shoe ; this is also the principle of the magneto-electric machines. The current induced by the rotation is double, sometimes inverse, sometimes direct, but it is easily reduced to a simple current, or one travelling always in the same direction. In order to do this it is sufficient to impart to the electro-magnet or coil a sufficiently rapid rotatory motion, and to collect only the current produced during the passage from one of its branches in a position which it is easy to determine. We realise with the currents thus engendered, all applications of dynamic electricity, to electrolysis, magnetism, mechanical labour, heat, light, &c. But I believe I have been the first to show by a very simple and unforeseen experiment that the effects produced depend essentially upon the diameter of the wire of the electro-magnet or coil, that is to say, on the greater or less resistance opposed to the current, at the very moment of its production. According to whether it is engendered under a weak or under a powerful resistance, it is capable or incapable of a certain effect, more or less powerful. This is the fact which led me to this conclusion :— I was experimenting with a small Billant machine, an improved reproduction, by a very clever French maker of the English machine of Clarke. Like every apparatus of this kind, Billant's machine had a double coil, one bobbin with thick and short wires, and one with the wires fine and long, which were by turns screwed to the axle of the machine, in front of and opposite to the magnet, according to the effect required, the bobbin with coarse wires for the magnetisation, and the bobbin with fine wires for the electrolysis of the water. With the bobbin of thick wires we succeeded in attracting to a small electro-magnet a weight of about 30 grammes, whereas, when traversed by the current of the fine-wire coil, this little magnet attracted absolutely nothing. Astonished at this result, I conceived the idea of making the current of the fine wire bobbin pass through the famous large magnet of M. Pouillet, which I borrowed from the Sorbonne, and, to my incomparably greater surprise, the current of my little machine, generated in a wire of very high resistance, although it did not attract 30 grammes to the little electro-magnet, magnetised the large one to saturation to the maximum of its power, and made it bear from 500 to 600 kilogrammes. This is one of the highly instructive experiments that I have regretted not having seen repeated at the Palais de l'Industrie. I tried it before many savants, in particular MM. Masson and Breguet, who, struck with the results that I obtained, used the bobbin with long wires to move, at a great distance, a magnetised bar, in which attempt they met with complete success. They did more, they took my little machine to the railway station at Grenelle, and verified what they could hardly believe, viz., that the current generated in the long wire passed through the rails without difficulty, in some way making light of their bad conductibility and off the interruptions in the way. This was in 1838, and since then every one has learnt that one of the most excellent motive apparatus in electric telegraphy is a magneto-electric machine, furnished with a bobbin of very fine wire, the length of which, always very considerable, must bear a certain relation to the length of the telegraph line. I feel it my duty to add that the laws of Ohm, which were almost ignored at the time of my experiments, explain very well the facts that I have just related. The induction current only produces appreciable effects when the length of the wire which receives it at its generation is in a certain relation to the resistance of the circuit which it is to traverse, *i.e.*, there must be a certain proportion between the power and the resistance. If the power be too great, or the resistance too weak, the current passes without making its presence and its action felt ; if the power is too weak or the resistance too great, the current is, as it were, stopped in its passage and produces no result ; in order to act, it must pass through the circuit with a certain amount of difficulty, but this difficulty must not be too great. L'Abbé F. Moigno.—*Les Mondes*, Dec. 1st, 1881.

ELECTRIC FORCE.—At the preliminary meeting yesterday of the Society for the Utilisation of Electric Force, M. Bontoux, who presided, delivered one of those speeches in which he excels. Yesterday, for instance, he remarked :— "The really aristocratic machinery, still almost intact, the employer's real privilege in the working world, is motive power. The artisan, who needs a little motive power for his work, is forced to seek it in the employer's factory, while thousands of workmen and workwomen wear up their bodies and destroy their strength in impelling the sewing-machine, the lathe, and the other motive powers of small industry. The division of electric energy is destined to effect an entire revolution in this sphere. The day will come, and sooner than is imagined, when the artisan family will see enter their dwelling, by means of a magic wire, the force which is now so costly to them, and this will be the democratisation of force for the benefit of the working class." This last phrase is a striking one, and foreshadows the solution of a difficult social problem. It points to the enfranchisement of the artisan, wherever individual can be substituted for collective toil, from the dependence imposed on him by the absence of motive power. The system of transmission of force to be worked by this company is that of M. Marcel Desprez, who took the chief prize at the recent Electric Exhibition.—*Times*, Paris Correspondent, Jan. 5th.

ELECTRICAL EXHIBITION.—St. Petersburg is to have its Electrical Exhibition, organised by the Technical Society. Several manufacturers of electrical apparatus and several Russian inventors have already promised their co-operation. —*Nature*, Jan. 5th.

ELECTRIC RAILWAY.—A Bill has been lodged for the construction of an electric railway under the Thames to connect Waterloo and Charing Cross Stations. The gradients will be such that very little power will be required to work the line.

TELEGRAPHIC COMMUNICATION IN SIBERIA.—It is officially announced that the Government have decided to establish telegraphic communication with Jakutsk. The length of the line between Irkoutsk and Jakutsk, which would consequently have to be constructed, is 3,000 versts.

THE LATE GALES AND THE TELEGRAPHS.—Mr. W. T. Henley, the well-known submarine cable manufacturer, thus writes to the London Daily Press :—

To the Editor,—Sir, my attention has been called to some remarks from one of your correspondents in a recent issue referring to the interruption of telegraphic communication during the recent gale. To avoid this very serious inconvenience, the writer advises the adoption of underground wire in place of the pole telegraphs now in general use in this country. The inconvenience of this mode of arranging our telegraphs, as well as the danger to which the public are exposed thereby, are well understood by all telegraphists, and did not require the experiences of the late storms to impress the importance of the question upon those engaged in telegraph construction. Some of the most important trunk lines of communication between London, Liverpool, and the North were, on their first establishment some thirty years ago, formed of gutta-percha insulated wires laid underground. It was soon found, however, that gutta-percha placed under these circumstances was subject to a species of dry rot, which rendered its maintenance in a condition of the necessary insulation for any length of time almost impossible. The buried wires were therefore abandoned, and the overground system universally adopted. Of late years, however, such advances have been made in improvements in underground insulators, that wires can be constructed insulated with a material which is absolutely indestructible under any circumstances. I allude especially to ozokerited india-rubber, which has been found quite unchangeable in its insulation, either in the soil, in the air, water, or when exposed to heat. I am now constructing for the Post-office authorities several hundreds of miles of telephone wires upon this principle, which it is intended to place underground. There is now no reason why all our most important trunk lines of telegraph should not be constructed on some such principle. The first cost is something less than the overground system wire, for wire and its maintenance does not entail any expense. As a case in point, the German Government have during the last two years laid several thousands of miles of underground wires on a modification of the old gutta-percha insulation, which is said to be effective in its working. It is, therefore, abundantly clear that there are now many systems of insulating underground wires of which the Post-office can avail themselves to obviate the serious inconvenience from interruption and even personal danger to which the public are exposed during winter storms under the present old-fashioned method of carrying land telegraphs through the country. Apologising for trespassing on your space, I am, sir, yours, &c., W. T. HENLEY.

Telegraph Works, North Woolwich.

WE can endorse Mr. Henley's statements respecting his "ozokerited india-rubber covered wires," having had personal experience with this material, and we do not doubt that it will shortly be extensively employed in underground work. Its behaviour under varying temperatures is remarkable, and it apparently suffers no deterioration under such heat as would render gutta-percha quite useless. We wish Mr. Henley all success with his core.

HENLEY'S TELEGRAPH WORKS COMPANY.—This company has manufactured during the past year about 400 miles of submarine cable to be laid between Cuba and Belize. The cable is made with the patent ozokerited core, conductor being 107 lbs., and insulation, 140 lbs. per nautical mile. It is sheathed with 18 No. 13 homogeneous wires. They have also made several lengths of submarine cable for the Submarine Telegraph Company, the Great Northern Telegraph Company, the Eastern Telegraph Company, and the Montreal Telegraph Company, &c., &c., and several lengths with their patent ozokerited core for the Swedish Government. They have supplied large quantities of ozokerited core to the Post Office to be placed underground and overhead for telephone purposes. This core is manufactured upon their patented principle of laying up the wires in pairs which effectually prevents inductive effects. They have likewise made several lengths of submarine telephone cables of their patent core for Sweden. This core has also become favourably known to electric light engineers, and they have manufactured large quantities of electric light cables for home and foreign use. They have executed orders for torpedo and military telegraph wires for the War Office, the United States Navy, the Argentine Republic, &c. ; their ozokerited core being supplied in every instance.

RAPID TELEGRAPHY.—It was announced by the Mayor at the close of the Birmingham meeting on Tuesday evening, that a telegram had been received from London to the effect that at 20 minutes past 9 o'clock the whole of the *verbatim* report of Mr. Bright's speech had reached the metropolis. The despatch of the reports of Tuesday's meeting was the heaviest, but at the same time the most rapid, piece of work of the kind yet performed at the Birmingham office. There were 202 press messages of the proceedings, consisting of either full or condensed reports. In respect of these, 182,152 words were actually transmitted through the various wires, but as some of the reports were written out in manifold on reaching their destination, the number of words delivered was 541,983. Mr. Bright began to speak at 7.25 p.m.; six minutes later the first page of longhand manuscript was handed over by the reporter to the telegraph officials in attendance at the hall, and at 8.38 the despatch to London, Manchester, and other stations began. Mr. Bright sat down at 8.35, and the last page of shorthand writers' notes of the report for London was transcribed and

despatched from the hall by three minutes to 9 o'clock. It was immediately "worked off" to London, whence the postal authorities acknowledged the receipt of the whole speech of 7,336 words at 9.20. Mr. Chamberlain's address followed, and afterwards Mr. Bright's remarks in thanking the Mayor. Mr. Chamberlain spoke 6,236 words. The despatch of the entire *verbatim* report was finished by 10.42 for Manchester, Bradford, and Liverpool; 11.5 for London; 11.15 for Leeds, Sheffield, and Edinburgh; 11.55 for Nottingham; 12.10 for Glasgow; and 1.6 a.m. for Dublin.—*Times*, 5th January.

TELEPHONE PATENTS IN AMERICA.—A November copy of the *New York Evening Post* contains a history of the labours of Daniel Drawbaugh, a Pennsylvania inventor, who claims to have given, in 1868, considerable attention to the construction of a telephone, which, it is claimed, was the first ever invented, and which combined all the parts of the Bell telephone now in general use. This Drawbaugh telephone is owned by the People's Telephone Company of New York, incorporated with a capital of 5,000,000 dolls., who have made application at Washington for a patent on Drawbaugh's invention, and covering every form of telephonic communication. The Bell Company object to the patent being granted, and have commenced a suit, claiming an infringement of their patent. A hundred of Drawbaugh's neighbours are to be called as witnesses, who are willing to swear that they personally tested and knew of the invention's practical use as far back as 1870. Referring to the instruments upon which Bell's two patents were obtained, the defendants claim that they are invalid and void, because the instruments are not patentable inventions, but are inoperative, useless, and worthless devices, and that, before the patents were issued, the same discovery had been made by Gray, Edison, and Drawbaugh, who were using due diligence in adopting and perfecting the same. The Bell Company claims that Drawbaugh abandoned his invention, and is consequently not entitled to any patent rights in view of that fact. Much of their evidence, however, will go to prove that Drawbaugh did not make use of an undulatory current such as Bell uses, but depended on the sound made by rapid interruptions of the current, something like the buzz of a telegraphic transmitter key worked very fast. Speech could be understood through it, but with more or less difficulty, and all voices were alike.

Another American paper, of November 16th, says:—"Proceedings were to-day begun in the United States District Court in this State (Connecticut), by the filing of papers in Hartford by the United States Telephone Company, asking for a permanent injunction to restrain the Connecticut Telephone Company from using speaking telephones, which are calculated to open up the most extensive telephonic litigation yet known in this country." The United States Telephone Company proceed for infringement of patents recently issued to James McDonough, of Chicago, on the so-called Bell telephones and battery transmitters.

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Last week there ended in Washington, D.C., a hearing in a suit of interference, ordered by the Commissioner of Patents, to decide the inventorship of the speaking telephone. The examination went into the work of all who claim patents on telephones, except that of Messrs. Dolbear and Holcombe. In the case of all others briefs were filed. Decision has not been rendered in this interference suit. Since notice was given of this hearing, the McDonough patents have been issued—one in August on the receiving telephone, one in September on a battery transmitter, and one in October on the combination which makes up the difference between the battery transmitter and the speaking telephone. These issues, those instrumental in bringing the injunction suit in Connecticut say, indicate that McDonough is entitled conclusively to be considered the original inventor of the speaking telephone. To sustain the present suit and others which are expected to follow, members of fifteen law firms have been retained. There are thirty other companies. The facts on which the McDonough patents were issued were presented before the recent hearing to the Commissioner of Patents. The claim is "that Mr. McDonough filed applications for letters patent on April 10th, 1876, under the title of 'teleloge,' which was before A. G. Bell had produced an articulating telephone. Bad management delayed the prosecution of the case. Logan C. Murray, of New York, of the United States National Bank of New York, bought the patent about one year ago, and he employed attorneys to press his claims before the examiner of electrical patents." Mr. Murray sold out his interest subsequently, but the patents have been issued for 17 years, as stated above.

CITY AND GUILDS INSTITUTE.—The London Turners' Company recently conferred its freedom on Sir F. Bramwell and Mr. Owen Roberts, clerk to the Clothmakers' Company, in acknowledgment of their services in promoting technical education in connection with the City and Guilds of London Institute. It was stated that thirty different trades are now engrafted in the movement, and Sir F. Bramwell was able to announce that the Grocers' Company had just given in its adhesion, with an annual subscription of £2,000. Professor Ayrton will continue his course of lectures on Electric Lighting and Electrical Instrument making.

IRIDIUM.—Mr. John Colland of Cincinnati has taken out a patent for a new process of working iridium, which is a very refractory metal. This method consists first of raising the metal to a very high temperature, after which phosphorous is mixed with it, and by means of this addition it can be run into a mould in a sufficiently fluid state to be shaped into the form required, and lastly the moulded mass is dephosphorised in a bath of chalk. This metal is much harder than steel, as it comes next to the ruby in hardness. Iridium cannot be forged by heating, nor can it be polished, and after being moulded it cannot be worked except with discs of copper with emery and water placed between.

The uses to which iridum can be put are many; but the most important up to the present is for the points of gold pens, as it renders them almost everlasting and gives them a softness, not possessed by those made of gold alone. This metal can also be turned to great account for incandescent electric lights. In an experiment made with it it remained incandescent for 60 hours without the least diminution of weight or change of form. Its property of not being oxidised or deteriorated by acids, as well as its hardness, suggest many applications for it in the future, and render it preferable to platinum for telegraphic instruments.—*La Gaceta de la Industria*, December 31st, 1881.

THE NEW ATLANTIC CABLE.—The steamship *Faraday*, left the works of Messrs. Siemens Brothers at Charlton on the 11th inst. with the last portion of the new Atlantic Telegraph Cable, which is to be forthwith completed for the American firm of Gould and Co. The cable is of special kind and remarkable for its strength, the shore end weighing eighteen tons per mile and the deep-sea and intermediate sections corresponding. More than 1,100 miles have been taken on board, at the rate of fifty miles per day, and the cable when complete will be 3,000 miles in length, the *Faraday* has made three previous voyages on the same work, leaving the end of the cable on each occasion buoyed in the Atlantic, where it has endured the storms of the past year without the slightest injury. Mr. Jacob, chief electrician, and a large staff are conducting operations, and the ship is in command of Captain Maypee.

OBITUARY.—New York, Jan. 4th.—The death is announced of Dr. John William Draper, the well-known scientific and philosophical writer, at the age of 71.

NEW PATENTS—1882.

14. "Apparatus used for electric lighting." A. MACKIE. Dated Jan. 2.

29. "Secondary batteries." D. G. FITZGERALD, C. H. W. BIGGS, and W. W. BEAUMONT. Dated Jan. 3.

49. "Improvements in measuring and recording quantity of electricity, and in the means or apparatus employed therefor." J. HOPKINSON. Dated Jan. 4.

55. "Distribution of electrical energy." J. PERRY. Dated Jan. 5.

64. "Magneto and dynamo-electric machines." L. A. GROTH. (Communicated by R. J. Gulcher.) Dated Jan. 5.

69. "Manufacture of incandescent lamps." E. H. T. LIVEING and C. O. BOYS. Dated Jan. 6.

71. "An improved system of automatic electric printing registers and return signals and apparatus therefor." A. J. BOULT. (Communicated by B. E. Valentine.) Dated Jan. 6.

72. "Secondary or reversible electric batteries." R. KENNEDY. Dated Jan. 6.

84. "Dynamo-electric machines." W. R. LAKE. (Communicated by E. E. Ball.) Dated Jan. 6.

85. "Machines and apparatus for generating and utilising electricity for lighting, heating or other purposes." W. R. LAKE. (Communicated by J. S. Williams.) Dated Jan. 6.

95. "Electric lamps." W. J. MACKENZIE. Dated Jan. 7.

118. "Telegraphy." P. JENSEN. (Communicated by F. W. Jones.) Dated Jan. 9.

120. "Improvements in the means of, and in the apparatus for storing electrical energy, and in the preparing of the materials to be employed." J. E. LIARDET and T. DONNITHORNE. Dated Jan. 9.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1881.

2038. "Electric lighting apparatus." H. J. HADDAN. (A communication from abroad by R. J. Gülcher, of Austria.) Dated May 10. 6d. Relates to the lamp described in the TELEGRAPHIC JOURNAL for November 15th, 1881.

2041. "Apparatus for controlling and localising electric currents." LUIS MARIE DE BEJAR Y O'LAWLOR. Dated May 10. 8d. Relates partly to improvements in apparatus known as autoquinetic signalling apparatus.

2057. "Magnetic comb." J. M. RICHARDS. (A communication from abroad by Patrick H. Drake, of New York.) Dated May 11. 2d. Consists in the combination of a comb with a permanent magnet, whereby is added to the friction of the said comb upon the scalp any physiological effect that may be derivable from the inductive action of the said magnet.

2079. "Electric lamps," &c. C. H. GIMINGHAM. Dated May 12. 2d. Relates to the hermetic sealing of the conductors carrying the carbon filament of an incandescent lamp into the glass envelope or bulb. (*Provisional only.*)

2175. "Regenerating or restoring the energy of electric batteries." W. R. LAKE. (A communication from abroad by Louis Maiche, of Paris). Dated May 18. 4d. Consists in regenerating the Leclanché battery by sending a current through it in the reverse direction to that which the battery normally gives.

2198. "Electric lamps." C. D. ABEL. (A communication from abroad by Wladimir Tschikoleff and Heinrich Kleiber, both of St. Petersburg.) Dated May 19. 6d. Consists in regulating the distance of the carbons by two small dynamo machines, connected in the circuit, which screw the carbons up or down.

2212. "Dynamo-electric machines." C. A. BARLOW. (A communication from Auguste de Meritens, of Paris.) Dated May 20. 2d. The new machine is composed of two magnetised clusters of horse-shoe form, each cluster has two arms (or branches) formed of 64 plates; these arms are arranged in a curve, so that their inner surface is equidistant from the periphery of a ring which rotates between them. (*Provisional only.*)

2308. "Signalling apparatus for railways." J. KING. Dated May 26. 10d. By this invention an engine-driver upon reaching a certain point places the danger-signal or signals in position, it remaining so until he has performed any shunting or other work of any duration, upon the completion of which, when passing another certain point, the danger-signal or signals are changed instantly to "line all clear."

2323. "Secondary electric batteries." J. H. JOHNSON. (A communication from abroad by La Société "La Force et la Lumière," Société Générale d'Electricité, of Brussels.) Dated May 26. 2d. Relates to improvements in secondary batteries. (*Provisional only.*)

CITY NOTES.

Old Broad Street, January 11th, 1882.

THE CUBA SUBMARINE TELEGRAPH COMPANY (LIMITED).

FROM the report of the directors for the half-year ending 31st December, 1881, it appears that the gross receipts, including the balance brought from last account, amount to £14,854 15s. 6d., and the gross expenditure, including the half of the annual payment for the new cable, to £5,689 10s., leaving a sum of £9,165 5s. 6d. to the credit of revenue account.

After placing £1,000 to the reserve fund, increasing that fund to £42,000, and providing for the dividend on the preference shares, a balance of £5,165 5s. 6d. remains, out of which the directors recommend the payment of a dividend on the ordinary shares at the rate of 6 per cent. per annum, free of income tax, leaving the sum of £365 5s. 6d. to be carried forward to the current half-year's account.

The directors have much pleasure in reporting that the cables continue in good working order, the new one remaining in the same excellent condition as when laid.

A comparative statement of the traffic for the past two years is also submitted.

THE WESTERN AND BRAZILIAN TELEGRAPH COMPANY.

THE ninth ordinary general meeting of the shareholders of this company was held on the 6th inst., at the City Terminus Hotel, Cannon Street. Sir Henry Drummond Wolff, M.P., in the chair. Major Wood, the managing director, read the notice convening the meeting, and the report (referred to in our last issue) was taken as read. The chairman: Gentlemen, since we had the honour of meeting you some time ago, you will have noticed by the circular that we sent you, that the actions this company had undertaken against certain persons had been compromised in the manner authorised by a general meeting. We have received nearly the whole of the sums mentioned in the report, a certain sum still remaining unpaid, but being amply secured, and we shall likely receive it very shortly. The working expenses, as you will perceive, have decreased by the amount of £4,525, and I think you will agree that on the whole the prospects of the company are more satisfactory than they have been for some time. The maintenance is remarkably high for enterprises of this character, but it is really more in the way of renewal than for maintenance, as the original deap-sea type, which was laid in shallow waters, was not adapted for the purpose, and has been exposed to damage more than it would have been in the deep sea, and more than any other type of cable in these particular shallows. We have, however, by dint of these large expenses, managed to replace the old type by a more satisfactory kind of cable, and we hope, in a short time, that the whole of the revenue-earning portion of the cable will be entirely replaced by the better type. Therefore we confidently anticipate, especially when the new cable which we have ordered is laid down, that in future the maintenance charges for the year will be very largely reduced. I have received several letters from different shareholders as to the application of the moneys that we have received in consequence of the compromise we have entered into, and I have also received letters from shareholders suggesting that we should declare a dividend out of the amount, but I think you will perceive that the declaration of a dividend from this money is an impossibility without certain previous steps being taken in the courts of law. The sums that we have thus recovered cannot be looked upon as profits. They are simply a replacement of capital, and must be treated as such, unless we get the authorisation of the courts, which, if circumstances render it necessary,

we would endeavour to get, for reducing our capital by the process laid down for that purpose in different Acts of Parliament. But, at the same time, even if we were entitled to divide this money, the shareholders, I believe, would not seriously think it desirable to do so at the present moment. We have despatched Mr. Cunningham, the Secretary, to Brazil to endeavour to come to some understanding with the Government there with regard to the competition of the land lines. That competition has been very injurious to us, and I do not think that the Government have fully appreciatad how unfair it was to carry it on. I have had communications from several persons who are competent to give an opinion, and our reports from Mr. Cunningham, though very short, by telegraph, as he has only been a short time in Brazil, yet lead us to think that the authorities are disposed to act favourably towards us. Of course negotiations of this kind must take up a certain length of time, but I think that the Brazilian Government, who has always been very just in its relations and in its dealings, does see the hardship of the position in which we are placed, and does not desire that the capital ventured by British subjects in Brazil should be lost by misunderstandings with the Government. More than this I cannot say at present, because the negotiations are of a very delicate character, and I should not like to raise hopes which might not be realised. But I do hope that the negotiations are likely to be concluded, and that before long I trust we may be in a far better position than we are at present. To come back to the question of dividing the money, I should say that it would be unwise at the present moment to part with any amount we have received, because our position is much stronger in these negotiations when it is known that we have behind us a large amount of money which may be employed in repairing the line, in guaranteeing repairs, and guaranteeing a certain revenue, or in fact giving our earnest of something profitable to the Government in case we enter into a successful arrangement with them. I therefore hope that the shareholders will support us in this view. The task before us is a difficult one, and has been so up to the present moment, but we are now in smoother waters than we have been for a long time. The intrinsic value of our enterprise is certainly considerably increased by the large amount we have already expended in renewing the line and replacing bad cable, from the increase of traffic, and also from having a portion of our capital replaced. With regard to the Central American Company's line, we are of opinion that for the present matters had better remain as they are. We are in possession of the concession with our partner in that line; we are in possession of the necessary concession for renewing it if it should be thought desirable, but at the present moment we think it would be unwise to take up the question unless other circumstances should arise to induce us to change our decision. I think that, though my explanations to you have been short, I have touched sufficiently on all points which are likely to interest you; but I shall be very glad, and so will my friend Major Wood, the managing director, to answer any question that you may think it necessary to raise with regard to this report. I cannot, however, conclude without once more expressing my own acknowledgments to Major Wood and Mr. Cunningham, as well as to the solicitors, for the great pains and care they have given in enabling us to conclude a compromise. That compromise, as I told you, was concluded on the advice of counsel, who were engaged at every step of the proceedings, and I hope that the result will be considered satisfactory and will prove advantageous to the company. I therefore beg to move that the report be now adopted.

Mr. Andrews: I beg to second that motion.

The Chairman: Does any gentleman wish to ask any questions?

Mr. Branch: Before the meeting proceeds to the discussion of more important matters, I just wish to notice what appears to me to have been an omission in the remarks you addressed just now to the meeting. You have told us that certain proceedings have been adopted against certain individuals, and that a certain sum of money has been recovered. I can understand that in the case of printed reports issued either by the company or by newspapers, there may be good reason for this anonymous treatment of the proceeding; but you—speaking now as one shareholder to other shareholders—can have, I take it, no sufficient reason for withholding from us the names and particulars. If I am in order—a point I would rather submit to your superior judgment than decide for myself—I would ask you what are the amounts already paid by the individual defendants, and who are those left out of the compromise, if any, and what are the proceedings now being adopted by the directors to recover such a further amount as in their estimation is due. I do not for a moment wish to cast a doubt on the good faith of the compromise you have effected either on the part of the plaintiff company or the defendant individuals. I only want to know who they are that have compromised, what it is they have paid, and what it is (if anything) you still hold to be due —(Hear, hear).

The Chairman: My honourable friend has asked me some questions which I do not think it would be quite prudent for me to answer. In the first place, before we made this compromise we summoned a general meeting of the shareholders, in which we stated to them the aggregate amount that was offered to us for the compromise, and we stated at the same time only that aggregate amount, and did so purposely, so as to avoid angry criminations which might have interfered with the progress of the compromise. The unanimous feeling of the meeting (which was testified to also by the large number of proxies we received) was that we should accept the compromise. We have done so, and I do not think it would be fair on those who have paid the money on the faith of the vote that was then come to by a general meeting for us to re-open the question or mention names. So far as I and the other directors are concerned, we have really had no object in view but that of doing justice to the shareholders, because none of us are concerned in the original establishment of the company. We came into it when the proceedings had already been begun, and we have no knowledge of the subject except from the statements of complaint that we ourselves filed and the answers which were put in by the defendants. But we are not judges. It is not for us to decide or to apportion blame or praise, or to condemn or acquit any body, and I, for my part, certainly would not undertake that task. We were offered a certain sum to compromise the whole proceedings. Nobody has been left out of the compromise; everybody has paid more or less, and therefore I think it would be far better to bury these proceedings and let them go into the past instead of opening up questions which might lead to recriminations as useless as the compromise has been effective—(Applause). However, if any honourable shareholder would like to come to the office and see Major Wood, I think that we could give him most satisfactory information on the subject, but I do not think that this is the place to make these statements. As I said before, there is no one left out of the compromise. There is one gentleman who is out of the jurisdiction, who, I think, will come in, but with the exception, which is a small one, everybody concerned who was a defendant in the suit has contributed to the compromise.

Mr. Pike: A gentleman near me, who perhaps is a little bashful, would like to know why with reference to the Central American Company you have arrived at the conclusion that it is worthless, and why you henceforth strike it out of the assets of the company.

The Chairman: I will ask Major Wood to answer you that.

Major Wood: Some little time ago a surveying ship was sent to report upon the condition of the Central American Company, Mr. Weise, the auditor, having some time previously called attention to the fact that nothing was being received from the company from that large asset on our books. The directors, therefore, reported to the shareholders their intention to send a ship to survey the cable. The survey was made, and the result of the survey, I regret to say, is that the cable is not of any practical value.

The motion for the adoption of the report was then put and carried unanimously.

Mr. H. Weaver and Mr. Earle were re-elected directors.

Mr. Pike moved the re-election of Mr. Weise, which was seconded by Mr. Kendall.

LATEST QUOTATIONS.

JANUARY 11th, 1882.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations, Jan. 11.	Business Done.
		ELECTRIC LIGHT.			
40,000	....	Anglo-American Brush Co.	4	8½ - 9½	9¼-9 3/16 a
....	....	Do. Do.	10	18 - 19	
150,000	5	Electric Light and Power Generator Co.	1	1¼ - 1⅝	1 5/16
		TELEGRAPHS.			
2,116,400l.	Stk.	Anglo-American, Limited	100	48½ - 49½	48⅞-½ ac 49-8½-½
2,441,800l.	Stk.	Do. Preferred } Def'd. receiving no div. until {	100	75½ - 76½	
2,441,800l.	Stk.	Do. Deferred } 6 p. c. has been paid to Pref. {	100	20½ - 21	20⅝
130,000	10	Brazilian Submarine, Limited	10	11½ - 11⅝	
16,000	10	Cuba, Limited	10	9½ - 10	
6,000	10	Do. 10 per cent. Preference	10	16 - 17	
13,000	10	Direct Spanish, Limited	9	4¾ - 5¼	
6,000	10	Do. 10 per cent. Preference	10	14½ - 15½	
65,000	20	Direct United States Cable, Limited, 1877	20	10½ - 10⅝	10½a
100,000l.	100	Do. 6 per cent. Debenture, repayable 1884	100	100 -103	
380,000	10	Eastern, Limited	10	10½ - 10⅝	
70,000	10	Do. 6 per cent. Preference	10	12½ - 12¾	12¾ ac
232,000l.	100	Do. 6 do. Debentures, repayable Oct. 1883	100	100 -103	
200,000l.	100	Do. 5 do. do. Aug. 1887	100	100 -103	
200,000l.	100	Do. 5 do. do. Aug. 1899	100	105 -108	
199,750	10	Eastern Extension, Australasia & China, Limited	10	11 - 11¼	
320,000	100	Do. 6 p. c. Debentures, repayable Feb. 1891	103	108 -111	
500,000	100	Do. 5 p. c. (Australian Gov. Subsidy) Deb. 1900	100	102 -105	
140,000	100	Do. do. registered, repayable 1900	100	102 -105	
100,000l.	100	Do. 5 per cent. Debentures, 1890	100	102 -105	
254,300l.	100	{ Eastern and South African Limited 5 per cent. } { Mort. Deb. Registered redeemable 1 Jan. 1900 }	100	101 -104	
345,700l.	100	Do. do. do. To Bearer	100	101 -104	
22,050	10	German Union Telegraph and Trust, Limited	10	9½ - 10½	
163,390	10	Globe Telegraph and Trust, Limited	10	6¼ - 6½	6⅜
163,209	10	Do. 6 per cent. Preference	10	12½ - 12⅝	12⅝
125,000	10	Great Northern	10	11¼ - 12¼	
100,000l.	100	Do. 5 per cent. Debentures	100	101 -104	
31,200	10	India-Rubber, Gutta-Percha and Telegraph Works	10	25½ - 26½	
100,000	100	Do. 6 per cent. Debentures, 1886	100	104 -108	
17,000	25	Indo-European, Limited	25	28 - 29	
38,148	10	London Platino-Brazilian, Limited	10	4¾ - 5¼	
12,000	10	Mediterranean Extension, Limited	10	2½ - 2¾	
8,200	10	Do. 8 per cent. Preference	10	9½ - 10	
9,000	8	Reuter's, Limited	8	12½ - 12¾	12⅝ ac.
280,000	Stk.	Submarine	100	290 -300	
58,225	1	Do. Scrip	1	2⅛ - 2⅜	
4,200	Cert.	Submarine Cables Trust	100	97 -100	
37,350	12	Telegraph Consolidated and Maintenance	12	28½ - 29½	
150,000	100	Do. 6 per cent. Bonds, 1884	100	102 -106	
186,750	5	Do. 2nd Bonus Trust Cert.	5	1½ - 1⅝	1⅝
30,000	10	West Coast of America, Limited	10	4¾ - 5	
69,910	20	Western and Brazilian, Limited	20	8 - 8¼	8 ac.
200,000l.	100	Do. 6 per cent. Debentures "A" 1910	100	110 -115	
2,500	100	Do. 6 p.c. Mort. Deb. series B of '80. red. Feb., 1910	100	99 -103	
1,500	$1,000	Western Union of U. S. 7 p.c.1 Mort.(Building) Bds.	$1,000	123 -128	
1,030,000l.	100	Do. 6 per cent. Sterling Bonds	100	104 -107	
88,321	10	West India and Panama, Limited	10	1⅞ - 2⅛	
34,563	10	Do. 6 per cent. 1st Preference	10	7⅞ - 8⅛	
4,669	10	Do. 6 do. 2nd do.	10	6¼ - 6½	
		TELEPHONES.			
154,165	1	Con. Telephone & Maintenance, Ld. Nos. 1 to 154,165	1	1⅛ - 1⅜	
200,000	1	Oriental Telephone Co.	⅛		
100,000	5	United Telephone Co.	5	11¼ - 11½	

TRAFFIC RECEIPTS.

Cuba Submarine Telegraph Company. December, £2,500 against £2,494 in corresponding period of 1880.

Direct Spanish Telegraph Company. December, £1,459* against £1,520 in corresponding period of 1880.

Great Northern Telegraph Company. December, £16,720.

West India and Panama Telegraph Company. December, £4,796 against £3,238 in corresponding period of 1880.

* Falmouth-Bilbao cable interrupted during 15 days.